Catalogue of American Amphibians and Reptiles.

Heyer, W.R. and M.M. Heyer. 2006. *Leptodactylus natalensis.*

Leptodactylus natalensis A. Lutz
Bubbling Frog

Leptodactylus caliginosus: A. Lutz 1930:2.
Leptodactylus natalensis A. Lutz 1930:7. Type locality, Natal, Brazil (see **Remarks**). Lectotype, National Museum of Natural History (USNM) 81130, adult male, collector and date unknown (see **Remarks**) (examined by WRH).
Leptodactylus petersi (sic, *petersii*): Parker 1933:7 (in part).
Leptodactylus podicipinus: Cochran 1955:326 (in part).
Leptodactylus caliginosus caliginosus: B. Lutz 1954: 177.
Leptodactylus wagneri: Heyer 1970:18 (in part).

• **CONTENT**. The species is monotypic.

• **DEFINITION**. Adult *Leptodactylus natalensis* are of moderately small size, the head is about as wide as long, and the limbs are moderate in length (see Table 1; Heyer and Thompson 2000 provided definitions of adult size and leg length categories for *Leptodactylus*). Male vocal sacs usually are not visible externally or weak and median. Male forearms are not noticeably hypertrophied. Adult males have two keratinized spines on each thumb; males lack chest spines. A single pair of dorsolateral folds is rarely absent (2%), usually short (46%), or moderate (53%) in length. The toe tips are narrow (13%), just swollen (31%), swollen (28%), just expanded (22%), or expanded (6%). The toes are fringed; the fringing unites to form basal webbing between the toes. The upper shank has scattered moderate-sized keratin-tipped tubercles (tubercles are white if keratin tips have fallen off). The outer tarsus has scattered small keratin-tipped tubercles. The sole of the foot is either smooth or has a few small keratin-tipped tubercles.

The upper lip pattern ranges from uniform to three distinct light vertical stripes, one obliquely sloping forward stripe extends from lower loreal region to the jaw, ending just before the level of the nostril. A second, weakly obliquely sloping backward stripe extends from under the anterior portion of eye to the jaw. A third stripe extends from the lower posterior portion of the eye to below the tympanum, and may be either interrupted or continuous with a light commissural gland stripe; light stripes may be dark bordered or not. A dark interorbital triangle is usually bordered at least anteriorly by a white stripe. There are usually two ill-defined middorsal dark chevrons, one in the area above the arm insertion and the second over the sacrum. The dorsolateral folds are somewhat darker than the adjacent areas. The species lacks light middorsal stripes. The belly rarely lacks a pattern (1%), occasionally is lightly mottled (7%), and

Figure 1. *Leptodactylus natalensis*, C.M. Carvalho field number 783 to be deposited in the MZUSP, from the campus of the Universidade Federal de Sergipe, São Cristóvão, Brazil (photograph courtesy of Celso Morato de Carvalho).

usually is either moderately (52%) or extensively (40%) mottled. The posterior thigh surfaces rarely (5%) have distinct light stripes, sometimes (16%) the stripes are indistinct, but usually (79%) light stripes are not discernible. The upper shanks have indistinct to distinct somewhat irregular, dark, moderately broad crossbands.

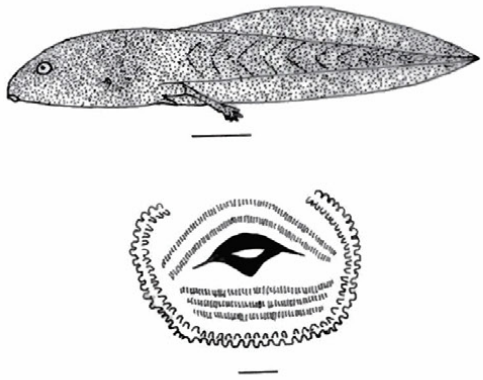


Figure 2. Tadpole of *Leptodactylus natalensis*, redrawn from figure 3 in Oliveira and Lírio Júnior (2000). Specimen from campus of Universidade Federal de Sergipe, São Cristóvão, Brazil. Upper scale bar = 5 mm, lower scale bar = 0.2 mm.

Larvae have a typical pond morphology and are members of the exotroph, lentic, benthic guild (McDiarmid and Altig 1999). The oral disk is anteroventrally positioned, entire (not emarginated), with an anterior gap lacking marginal papillae. There is a double row of marginal papillae. No submarginal papillae are present. The tooth row formula is 2/3. The spiracle is sinistral and the vent tube is median. The dorsal fin originates at the body/tail junction. At Gosner stages 39/40 the total length is 28 mm with a body length of about 14 mm; the eye diameter is

about 10% the body length; and the oral disk is about 50% of the body length. The body and tail musculature are ash-brown with gold punctuations; the dorsal and ventral tail fins are uniformly black (description based on Oliveira and Lírio Júnior 2000).

Table 1. Summary measurement data for *Leptodactylus natalensis* (means are in parentheses).

Measurement	Males	Females
SVL (mm)	29–42 (34.5)	33–49 (40.0)
Head length/ SVL (%)	35–42 (38)	33–40 (37)
Head width/ SVL (%)	33–39 (36)	30–38 (34)
Thigh length/ SVL (%)	39–49 (44)	38–48 (43)
Shank length/ SVL (%)	41–48 (46)	41–51 (45)
Foot length/ SVL (%)	44–58 (53)	46–57 (52)

The advertisement call consists of a single note per call, given at a rate of 180–250/min. Call duration ranges from 0.06–0.07s. The call is pulsed or partially pulsed (= incompletely amplitude modulated), with 2–7 pulses or partial pulses per call. The call attains maximum intensity in the first 1/5 to 1/2 of the call and attenuates more or less regularly for the remainder of the call. The calls are frequency modulated with extremely rapid rise times. Beginning carrier (also equal fundamental) frequencies range from averages of 550–770 or 1020–1040 Hz to maximum average carrier frequencies of 1370–1830 Hz. Harmonics are either weak or not discernible.

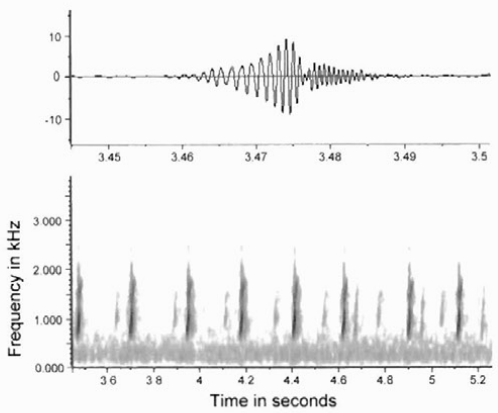


Figure 3. Wave form and audiospectrogram displays of the advertisement call of *Leptodactylus natalensis* (USNM recording 323, cut 1) from the campus of the Universidade Federal de Sergipe, São Cristóvão, Sergipe, Brazil, voucher specimen MZUSP 89945. The wave form is that of the first call shown on the audiospectrogram.

• **DIAGNOSIS**. The species having distinct toe fringes and no more than a single pair of moderate length dorsolateral folds in some or all individuals are *Leptodactylus colombiensis, discodactylus, diedrus, griseigularis, leptodactyloides, melanonotus, natalensis, nesiotus, pascoensis, petersii, podicipinus, pustulatus, sabanensis, silvanimbus*, and *wagneri*. *Leptodactylus diedrus* and *discodactylus* have at least one transverse groove on the dorsal surface of the largest toe disk; the toes of *L. natalensis* are not disked or grooved. *Leptodactylus natalensis* (males ≤ 42 mm SVL, females ≤ 49 mm SVL) are smaller than almost all *L. pascoensis* and *wagneri* (males ≥ 39 mm SVL, females ≥ 52 mm SVL). *Leptodactylus natalensis* cannot be consistently diagnosed from the remaining species based on morphology. The only other species that occurs in the same general geographic region with *L. natalensis* is *L. podicipinus*. No individuals of *L. natalensis* have distinct light belly spots whereas many *L. podicipinus* individuals do. Just over half of *L. natalensis* specimens have toe tips larger than narrow or just swollen whereas all *L. podicipinus* specimens examined have toe tips that are either narrow or just swollen.

• **DESCRIPTIONS**. A. Lutz's (1930) original description of *Leptodactylus natalensis* included color. His description of *L. caliginosus* in the same paper is of *L. natalensis*, as well. Heyer (1994) provided detailed morphological descriptions of adult females and males. Oliveira and Lírio Júnior (2000) described morphology and color of adult and larval specimens. Accounts of advertisement and chirp calls of *L. natalensis* are in Heyer and Carvalho (2000), and the karyotype is described in Bogart (1974).

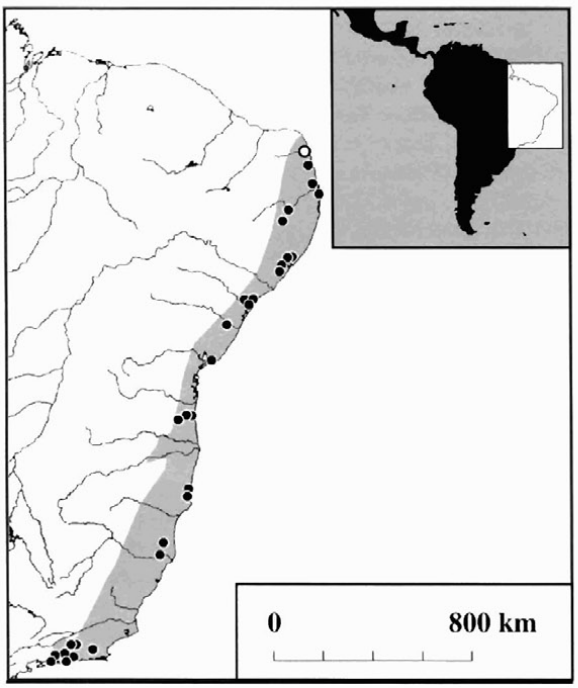
• **ILLUSTRATIONS**. Color photographs of adults are in Izecksohn and Carvalho-e-Silva (2001b), Freitas and Silva (2004, 2005), and Oliveira and Lírio Júnior (2000). A. Lutz (1930) provided color illustrations and black-and-white photographs of *L. natalensis*. His color illustrations and black-and-white photographs of *L. caliginosus* in the same paper (A. Lutz 1930) are of *L. natalensis*. Black-and-white photographs of adults are in Bogart (1974) and Izecksohn and Carvalho-e-Silva (2001b), while an illustration of an adult, as *L. caliginosus*, is in B. Lutz (1954). Oliveira and Lírio Júnior (2000) offered figure drawings of a larva and a larval mouth. A camera lucida tracing of the terminal phalanx is found in Heyer (2000). Wave forms and audiospectrograms of both the advertisement and chirp calls are illustrated in Heyer and Carvalho (2000) and a power spectrum of the advertisement call is also pictured. Bogart (1974) displayed a photo of the karyotype and an ideogram of the normalized length of the chromosome.

• **DISTRIBUTION**. *Leptodactylus natalensis* is associated with northern and central portions of the Atlantic Forest Morphoclimatic Domain (Ab'Sáber 1977) from its most northern extent in the State of Rio Grande do Norte to and including the State of Rio de

Janeiro (see **Map**).

Fabio (1985 as *L. caliginosus*), Heyer and Carvalho (2000), Izecksohn and Carvalho-e-Silva (2001b), and Oliveira and Lírio Júnior (2000) have found the species in forest and at forest edges. Heyer (1994) noted its capture at 50 m elevation.

References to distribution and/or localities in Brazil include Bogart (1974), Bokermann (1966), Cochran (1955, as *L. podicipinus* in part), Duellman (1999), Fabio (1985, as *L. caliginosus*), Heyer (1994), Heyer and Carvalho (2000), Izecksohn and Carvalho-e-Silva (2001a,b), A. Lutz (1930, as both *L. caliginosus* and *L. natalensis*), B. Lutz (1954, as *L. caliginosus* and *L. caliginosus caliginosus*), Myers (1946, as *L. caliginosus*) Oliveira and Lírio Júnior (2000), and Santos et al. (2004).



Map. Distribution of *Leptodactylus natalensis*. The type-locality is indicated by a circle. Dots mark other localities. A dot may represent more than one site. Published locality data used to generate the map should be considered as secondary sources of information, as we did not confirm all specimen localities. The locality coordinate data and sources are available on a spread sheet at http://learning.richmond.edu/Leptodactylus.

• **FOSSIL RECORD.** None.

• **PERTINENT LITERATURE**. The following literature is listed by topic. The symbol **(M)** indicates a species mention, and (**S**) is a secondary source: **bibliographic information and lists** (Liner 1992); **call and call parameters** (Heyer and Carvalho 2000; A. Lutz 1930 as both *L. caliginosus* and *L. natalensis*; B. Lutz 1954 as *L. caliginosus*); **conservation** (Rodrigues 2003, 2004; Young et al. 2004); **ecology, natural history, reproduction** (De la Riva 1993 (**M**); Fabio 1985 as *L. caliginosus* (**M**); Heyer and Carvalho 2000; A. Lutz 1930 as both *L. caliginosus* and *L. natalensis*; B. Lutz 1954 as *L. caliginosus*; Oliveira and Lírio Júnior 2000, Rodrigues 2003, Santos et al. 2004); **field guide** (Freitas and Silva 2004, 2005); **faunal lists** (Freitas and Silva 2004; B. Lutz 1954 as *L. caliginosus*; Myers 1946 as *L. caliginosus*; Rodrigues 2004); **faunal lists** (Freitas and Silva 2004, B. Lutz 1954 as *L. caliginosus*; Myers 1946 as *L. caliginosus;* Rodrigues 2004); **habitat** (Heyer and Carvalho 2000; Jim 1980 as *L. caliginosus* (**M**)); **karyotype** (Bogart 1974; Heyer 1974 (**S**), 1994 (**S**); Heyer and Diment 1974; King 1990 (**S**); Kuramoto 1990 (**S**); Moreschalchi 1979 (**S**), Silva et al. 2000 (**M**)); **keys** (B. Lutz 1954 as *L. caliginosus caliginosus*; Oliveira and Lírio Júnior 2000); **morphology** (Heyer 1994; Heyer and Carvalho 2000; Izecksohn and Carvalho-e-Silva 2001b; Liu 1935a,b; A. Lutz 1930 as both *L. caliginosus* and *L. natalensis*; B. Lutz 1954 as *L. caliginosus*; Oliviera and Lírio Júnior 2000); **nomenclature and taxonomy** (Cei 1980 (**M**); Heyer 1970, 1974 (**M**); A. Lutz 1930 as *L. caliginosus*); **parasite host** (Fabio 1985 as *L. caliginosus*; Fabio and Izecksohn 2001); **relationships and systematics** (Bogart 1974, Cei and Erspamer 1965 (**M**); Gallopín 1962 (**M**); Heyer and Diment 1974; Savage 2002 (**M**)); **species accounts** (Heyer 1994; Izecksohn and Carvalho-e-Silva 2001b; A. Lutz 1930 as both *L. caliginosus* and *L. natalensis*; Oliveira and Lírio Júnior 2000); **species comparisons** (Heyer 1994, 2000; Heyer et al. 2002; A. Lutz 1930 as *L. caliginosus*; B. Lutz and Kloss 1952 (**M**); Oliviera and Lírio Júnior 2000); **species or taxonomic lists** (Gorham 1966 as *L. podicipinus petersii*, 1974 as *L. podicipinus*; Lavilla 1994 (**M**); Rocha et al. 2004); **type lists** (Cochran 1961).

• **NOMENCLATURAL HISTORY**. Parker (1933) synonymized *L. natalensis* A. Lutz 1930 with *L. petersi* (sic for *petersii*) (Steindachner 1864). Cochran (1961) listed *L. natalensis* as a synonym of *L. podicipinus* (Cope 1862). Heyer (1970) considered *L. natalensis* to be a synonym of *L. wagneri* Peters 1862. Bogart (1974), based on karyotypic data, proposed that *L. natalensis* and *L. wagneri* represented separate species. Heyer (1994) supported Bogart's proposal based on morphological data.

• **REMARKS**. "Rã caliginosa" was coined by B. Lutz (1954) as a common name for *L. natalensis* as *L. caliginosus caliginosus*. Izecksohn and Carvalho-e-Silva (2001b) called the frog "Rã borbulhante," or "Bubbling Frog," in reference to its call. Freitas and Silva (2004) used "Caçote" and (2005) "Caçote-borbulhante" for the species.

A. Lutz gave the type-locality as "Natal. Rio Grande do Norte. Rio Baldo e outros lugares" in the Portuguese text (1930:7) and as "Rio Bahú and other places near Natal (Rio Grande do Norte)" in the English text (1930:26). Rio Baldum, 06° 09' S 35° 08' W, is likely the type-locality (P.E. Vanzolini, pers. comm.). A. Lutz described the type material as "vários machos e fêmeas adultos" (1930:7) and "many adults of both sexes" (1930:26). Heyer

(1970:22) designated USNM 81130, a male with the catalogue data Natal, Brazil, collected July 1925, received from A. Lutz (no collector given), as the lectotype of *L. natalensis*. The lectotype was part of A. Lutz's type series, so presumably the lectotype was collected from Rio Baldum. See Heyer (1994:81) for further discussion of the type series.

• **ETYMOLOGY**. The specific name alludes to the general locality where the frog was initially collected.

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